

## **Distribution Interconnection R&D – Now and the Future**

### **Envisioning the Next Generation Grid: The Role of DER**

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Thank you Bill and good morning. It is especially nice to be here to speak about a topic that evokes so much passion and interest within the DTE Energy organization – distributed resources. The idea that small, on-site power producing units bring cost effective solutions for grid and non-grid power needs is not a new one within the Company. Detroit Edison began investing in and demonstrating uses for DR as far back as 1994.

Our vision, as explained by Chairman, Tony Earley is that “Today’s existing electric and gas system will be around for a long time. But we will also see a vibrant market for personalized power that uses distributed generation technology. In fact, utilities will be among the first real-world, large-scale users of distributed generation. Distributed generation will increasingly become a cost-effective alternative to the expansion and reinforcement of T&D infrastructure.”

We believe that DG is the best way for DTE Energy to leverage its existing infrastructure, manage its short duration peaks, improve customer reliability and continue its environmental stewardship. These beliefs are today demonstrated

through the creation of DTE Energy Technologies, a non-regulated business created to bring distributed generation to market. And through the integration of DG into Detroit Edison's distribution planning and operating process as an alternative to traditional means of satisfying distribution needs.

Distributed generation helps increase the efficiency of the nation's electric system:

- It eliminates the need for transmission and distribution systems that are typically overbuilt to accommodate future load growth;
- Reduces the efficiency losses through the transmission and distribution system;
- Utilizes waste heat in cogeneration applications; and
- Provides a better balance of supply and demand by siting generation at the place of use.

### **Detroit Edison DG Applications**

Utility DG Solutions - Detroit Edison is already using DG to supplement the traditional electric grid in areas where rapid growth is straining the distribution system. In 1999 one local community ended a moratorium on residential development. Due to rapid growth after the moratorium ended a new substation was needed in the middle of a geographic area served by three substations. A substation was originally planned to meet the 2001 summer peak load but was delayed because of difficulties encountered with obtaining local approvals. The

Company was able to serve the area in 2001, but there were capacity constraints. In 2002 there was not enough capacity to serve the area resulting in customer interruptions. Not only did customers suffer from the interruptions, but the utility lost revenue from the unserved load.

In 2002, a portable substation was installed and circuit reconfigurations were performed in the area (traditional T&D solutions) but there was still not enough capacity to serve the load. Low voltage (96 volts) and the intentional interruptions to customer occurred. A 2 MW generator was installed in 5 days toward the tag end of a circuit where the capacity need was the greatest. It operated during peak times to add capacity to the overloaded circuit. No intentional interruptions occurred after the DG was installed and adequate voltage was maintained. A permit to build a substation was finally approved in July of 2002 after the 2 MW diesel was installed. Having the unit installed greatly helped to approve the project with little local opposition.

The cost of reconfiguring the circuit, installing a portable substation, and lost utility revenue amounted to \$595,000. The DG rental, installation and fuel cost an additional \$309,000. These expenses were offset by deferring the capital expense of constructing a new substation over a two year period of \$1.1 million. The overall economics of the project resulted in a net savings of approximately \$200,000.

Another example of employing DG is found in a rural area where load growth is not an issue. A circuit in the thumb area of Michigan is fed by a single 2.5 MVA transformer with not much capacity margin for new growth and extra demand associated with above average temperatures. A portable transformer oil cooler had been installed previously to maintain low oil temperatures for loading above two times the nameplate rating as a stop gap measure. The solution was installation of a 1-MW natural gas fired engine generator set to avoid continued operation of the transformer at the excessive loading level.

After contact with the community, permission was granted to proceed with the construction. The installation was allowed by the community in part because the generation was for their use only and not for resale as in a merchant plant. The community sought assurance from Detroit Edison that completion of the expansion plans would take place within a couple of years. But the entire construction took only 12 days to complete following site approval. The installation cost of \$750,000 was \$100,000 less than the alternative of a traditional substation expansion.

In another rural area, an alfalfa plant was looking to expand its drying operations. Connection to a nearby radial feeder was causing unacceptable flickers and voltage drops when starting large motors. The traditional solution calls for installation of a 40 kV line from the nearest utility substation to the facility three miles away, along with the construction of an industrial grade substation at the

facility for voltage step down and disconnect. The total cost was estimated at \$2.5 million. The alternative was the installation of four - 400 kW mini-turbines at a savings of \$1.0 million. The localized DG solution was not only less expensive but it had built in redundancy for improved reliability. And it could save the customer the cost of a standby generator.

These types of unplanned uses of DG are being supplanted by a more formal program to integrate DG into the engineering planning cycle. Detroit Edison has been implementing EPRI's Distributed Engineering Work Station (DEW) as its power flow and short-circuit modeling program. And it is integrating DG directly into the planning cycle. To do this, Detroit Edison will first identify the planning criteria shortfall in kilowatts, estimate the duration, and calculate the cost of providing this shortfall of power. The analysis also takes into account other elements of cost, such as the need for new land and specific customer load additions. The Company plans to implement DG solutions when it is economically viable. This requires distribution engineers to review past summer peak loads and project the uses of DG to meet next summer's peak. This means the utility must preplan (both emergency and temporary needs), document installations and perform continual design improvements. To better control time and cost factors, the installations are being standardized.

Utilities frequently perform maintenance on their substations and, during those periods, cease service to customers on the circuit. By using a mobile generator

this past fall Detroit Edison not only continued service to 800 customers but retained revenue of \$8,640 that would have otherwise been lost.

Mobile power units can save utilities money in other ways as well. A unit deployed to support a 40 kV line undergoing maintenance enables the Company to continue serving customers. It would have cost \$90,000 to reconfigure the distribution system to continue serving these customers during maintenance. With the DG unit the Company owns, it can save that expense.

Customer Sites – DG solutions don't all have to be installed on utility property. Detroit Edison is testing a Customer Premium Power Program on targeted overloaded circuits. This is a potential win-win situation for both the utility and customer. The customer has use of the power generator during periods when the grid is down. The utility operates the generator during peak periods or other times when there is an electrical system requirement. The two entities share the cost of installing DG at the host company's facility with the utility bearing the initial installation cost and the business paying a monthly charge per kW.

The main objective of the Premium Power Program is to test customer acceptance and willingness to pay for on-site generation as an alternate high-quality power source. Customers have signed three-year contracts and agreed to retain Detroit Edison as their energy provider.

### Back to the Future:

When we look at the evolution of Distributed Energy applications, an important step is the shift from using small scale onsite generation only for emergency or temporary power, to one of providing continuous, highly reliable, high quality energy for homes, businesses and industry: one which efficiently uses on-site waste heat and thus conserves our natural resources and protects the environment.

Onsite power generators represent approximately ten percent of all power generating capacity in the U.S. The major applications include:

- Standby power to back up the grid in times of power outages;
- Peak shaving to avoid the high cost of power during high cost periods;
- Continuous use in high electric cost areas or in geographically remote locations; and
- Large scale CHP, or cogeneration, used at industrial sites or large commercial facilities.

In today's markets we see the evolution of DG beginning to take hold in a number of ways. First, the use of onsite power for improved reliability and quality. Today's users of electric power often demand more consistent power than the traditional grid can deliver. Growth of the digital society has been the primary mover for this change. Second, is the use of onsite power using the waste heat in CHP applications. Typical installations take place in: hospital or nursing homes; health clubs; multi-story apartment houses; hotels and resorts;

and schools. Third, is the use by real estate owners to enhance the profitability of their properties by selling power to tenants. Lastly, we are witnessing utilities employing it for peak shaving and applications like those of Detroit Edison reviewed above.

As we look towards the future we see the rollout of Microgrids – systems of multiple power sources of potentially different sizes and technologies to serve aggregated electrical and thermal loads, where the power and thermal energy can be produced at or near the locations of the users. In the mid-term, microgrids are expected to play a large role in making DG a reality for serving premium power parks, shopping centers, multi-family buildings and office buildings. Builders, developers and real estate owners can achieve added returns and an ongoing source of revenue through the sale of power. And utilities can provide power to remote communities.

Microgrids can deliver the type of power quality to run digital equipment and provide the high level of reliability required in today's businesses. Power outages or poor quality power can shut down data processing equipment or a manufacturing plant's operations costing up to hundreds of thousands of dollars per hour.

Microgrids are designed with redundant generation and underground cables to eliminate outages. They can be sited much faster than a central plant that can

take years to receive the necessary permitting and construction. And they can be built at a lower cost. Equally important is the ability of microgrids to aggregate the productive use of waste heat for local heating and cooling, blending the needs of perhaps a variety of adjacent commercial properties with residential consumers. Utilities can take advantage of microgrids as well by installing them in areas that are capacity constrained such as in central cities or in remote areas where bringing in power lines over long distances can be expensive.

Finally, we expect to witness the development of “virtual utilities”. Virtual utilities are business entities which may include both traditional utilities as well as a new breed of energy supplier, who build and operate a network of microgrids that aren’t necessarily physically contiguous or limited to a particular state or region.

In a “virtual utility”, power generators are controlled from a central operating center using the Internet and advanced control and communications technologies. Power can be dispatched for use by other microgrids or exported to or from the open market.

While incumbent utilities have a logical role in creating virtual utilities, a wide variety of new competitors may emerge including local homeowner associations, real estate developers, and mass marketers. Virtual utilities not only create more options for consumers, they create a much more robust opportunity for energy trading and marketing.

As DG technology and its application continues to evolve, the make-up of the traditional utility system will rapidly change – from a vertically integrated central station based utility with significant T&D assets and investments...to...a new kind of electrical system that leverages the benefits of both the traditional system and DG technology.

Today, most forms of DG use very simple local controls or at most very limited remote diagnostics. We are beginning to see controls and communications that allow idle standby generators to be dispatched to provide reserve capacity for the local grid while providing economic benefits to owners and utilities.

Soon, there will be systems leveraging the Internet and software applications allowing very sophisticated remote monitoring, control and management. These systems will eliminate a significant barrier for customers who want to leverage DG technology but do not have the desire or the capability to effectively or efficiently operate the technology.

Finally, with the help of this technology, there will be systems in place that can integrate hundreds, if not thousands, of DG systems into a virtual power plant, importing and exporting power to and from the traditional grid, optimizing power availability, security and economics.

## Regulation

As many of us know, today's regulations are hampering the growth of this new industry. For example, interconnection requirements are subject to local jurisdiction and generally fall into two areas – technical standards and local utility approval processes. Both of these areas vary not only by state but also with each electric utility throughout the country. This makes it difficult for DG suppliers (equipment manufacturers, energy suppliers and installers) to create low cost options for end-users.

Over the past few years the IEEE has been working towards creation of a single technical standard, P1547, which would apply for all distributed generation installations. We were extremely pleased to hear that the latest ballot met with approval and are looking forward to adoption of this new standard. And we hope to see that the other IEEE standards for testing, application and monitoring all meet with similar acceptance.

Last summer the FERC issued an ANOPR designed to provide a national interconnection process for generator owners of less than 20 MW for wholesale use. DTE Energy is proud to have taken part in that process, working with the Small Generation Group, and looks forward to seeing it progress beyond the proposal stage to a final rulemaking. Through research associated with a DOE contract affiliated with this program, DTE Energy Technologies helped support the Small Generation Group position in the proceedings.

Regulation also relates to ownership issues. The regulations written for electric utilities are rooted in the Public Utility Holding Company Act and by state laws administered by public utility commissions. Much of this regulation dates back to the 1930's, a time when society could only envision that low cost power would come from large, central station power plants. Today, there is a need to revisit these regulations due to the technology revolution that has changed the use of power and the development of small, efficient, reliable on-site power producing equipment.

Utilities in some states are not able to deploy DG to help supplement grid power and bring cheaper, better service to their customers. And companies affiliated with an electric utility are restricted from owning and selling power outside their current states. We need to revisit the current PUHCA regulations that limit or restrict ownership and resale of retail power to consumers.

Some states such as New York have adopted programs that call for utilities to seek uses of DG on their systems and explore the economics of a traditional solution versus a DG solution. The utilities are expected to install one or two such DG systems on the grid as part of this program. More programs like this could help utility design engineers find more uses for DG.

### DTE Energy Technologies

DTE Energy not only supports distributed energy through its efforts at the utility level. The Company's commitment to this business is so strong that it created a wholly-owned subsidiary named DTE Energy Technologies in 1997. Today, this company has 16 offices located throughout North America ranging from Toronto in the north to Orlando in the south; from Long Island in the east to Sacramento and Los Angeles in the west. The Company's goal is "To become the premier integrator of distributed generation technology."

As a technology neutral company we work with a varied array of products based on differing prime-mover technologies. We believe that successful DG companies need to do far more than provide hardware solutions for customers. Our business is fully supported by our ability to provide up-front applications engineering by working closely with customers to choose the correct technology, size of equipment, and use. We perform an economic analysis in configuring an optimized DG installation based on load profile and local rate structure. We can install, service and even operate the energy system for customers. And through our own Systems Operation Center we enhance our ability to perform service by monitoring, operating, and managing equipment remotely.

The Systems Operation Center or SOC is designed for three levels of service. Health monitoring of operating parameters to assure that an installation is operating properly. If a problem is detected a service person can be dispatched immediately, even if a unit is still operating. A higher level of service provides for

the remote operation and economic dispatch. The highest level enables the user to participate in energy trading by selling power when open market prices make it economical. Today there are 100 units operating with the SOC accounting for 25 MW of power.

Products in the current portfolio include units powered by traditional gas-fired internal combustion engines, advanced reciprocating engines, Stirling (or heat fired) engines and fuel cells. In the near future mini-turbines are expected to be added as well. A few years ago we thought this business would be built around new technologies like micro and mini-turbines, fuel cells and Stirling engines. But frankly, much of today's market is being filled with internal combustion engines that continue to stand the test of time. We do believe that other technologies offer much promise and will make large strides into commercial markets in coming years.

The Stirling engine we are working with is currently in Beta testing with 40 units under installation. Commercial rollout of a 52 kW sized energy system will be available this summer. One of our other partners is developing an advanced IC engine with EGR that we plan to demonstrate later this year. It promises to offer low emissions and high efficiency, both key attributes for today's and tomorrow's marketplace. And we have turbine programs in place that target the mid-sized range of products with what we call mini-turbines. These products are based on aero-derivative turbine technology.

At DTE we are also doing our part in looking even further out on the technology horizon. A few months ago the Department of Energy selected our Company as its partner in a first-of-its-kind hydrogen power park project. This groundbreaking project will model a post-fossil fuel hydrogen economy. It will be the first project to demonstrate how a non-fossil, fuel-based system could work toward the end of this century – from the generation of hydrogen, to its transmission, storage, distribution, and ultimately, conversion into electricity or fuel for transportation.

This is our vision of the next generation grid and where we think the utility and distributed energy businesses are headed. Let us finish by exploring some other reasons why a distribution company would embrace its use.

There is a growing trend toward holding distribution companies accountable for service and quality. These performance based ratemaking (PBR) concepts include both reliability and efficiency benchmarks that are ratcheted down over time. Distributed generation can be a critical tool to manage both cost and service levels on the distribution grid. It can provide system reliability by lowering the probability of system outages and help to provide various ancillary services.

A major threat to a distribution company is the loss of revenue due to the adoption of distributed power not owned by the regulated utility. The typical utility

distribution tariff is approximately \$.04 per kWh. Its operating, maintenance, overhead cost, and depreciation typically run \$.035 per kWh, leaving \$.005 per kWh for profit. If this typical utility has a two-million meter customer base that sells 40,000 GWH of power per year an instantaneous 5% penetration of distributed generation would lead – all other things being equal – to lost revenues of \$80 million, or a 40% reduction in profits. That's a large threat!

Distribution utilities do not necessarily lose their obligation to supply retail customers with power, despite the advent of customer choice. They remain exposed to the power market's volatility and must still procure and deliver power. Typically, the distribution utility will purchase most of its obligation in long-term power supply agreements with generation companies and will be largely hedged. But some power will have to be purchased from the spot market, especially to meet unforeseen loads. While peak power prices tend to run about \$40-60 per MWH during most of the year, the prices have soared in almost every power market to \$300-800 per MWH or more during the highest peak periods. Distributed generation is an effective, predictable mechanism for utilities to acquire power (or shed load) rather than go to the spot power markets. Thus distributed power is another form of hedge on the power markets, in the form of a call option, and is more under the company's own control. And it brings minor and highly diversified technical risk of malfunction.

In closing, let me say that there are today several economic uses of distributed generation that are contributing to the improved distribution of power. That over the next few years we will uncover many more that will benefit consumers, utilities and stockholders alike. The work being done here that creates a “bridge to the future” through improved interconnection and distribution systems is contributing greatly toward that end. Through this work we will see the vision we discussed earlier come to fruition; and also meet DOE’s DER market penetration goal of 20 percent of additional generation capacity by 2020.

Thank you again for the opportunity to address this conference, and may the next few days prove valuable in moving distributed energy forward.